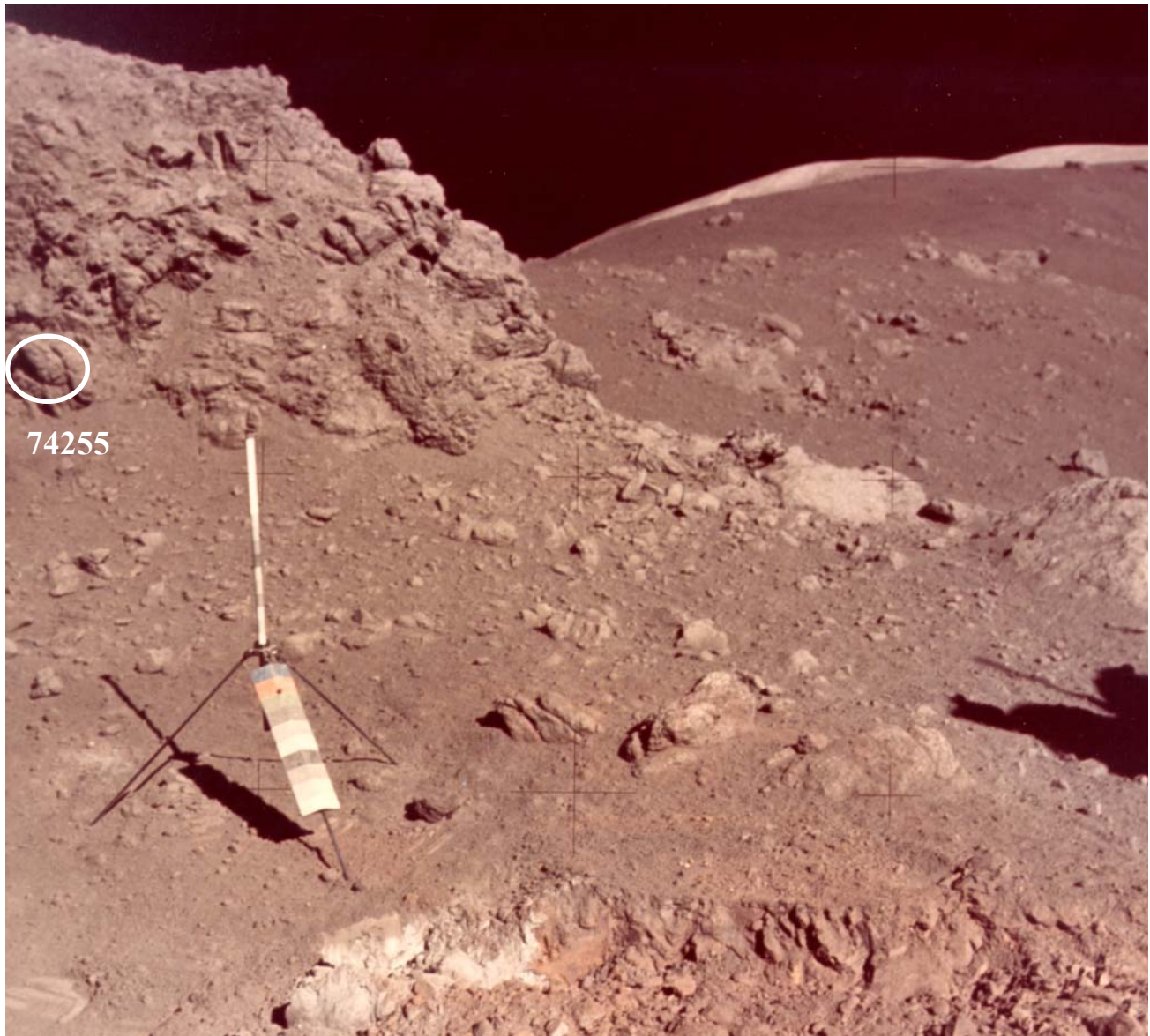


**74255**  
**Ilmenite Basalt**  
737.6 grams



*Figure 1: Picture of 5 meter boulder on rim of Shorty Crater showing where 74255 was collected. Trench in foreground is location of orange soil sample 74220. Photo number AS17-137-20990*

- CC We'd like to get a quick sample of the basalt up there on the rim, and Gene's stereo pan, and then press on.
- LMP OK, Bob, I'll get a sample. I'll sample it by hand. But, it'll be documented. And I'll get it in a bag in a minute since I don't have any. Basalt (74255) is in bag 512.
- CDR From where I am, about 100 meters around the west side of the rim of this crater, the mantle on the inside of the rim runs from this gray material we've been

sampling in here – to a very dark gray material. And there's a lot of . . . stuff that goes down – radially down into the pit of the crater. I got to take a couple more pictures at that contact slope over there. I know you can't see it from where you are jack, but I guess we got to leave. Otherwise it would be nice to sample that dark stuff up on top.

LMP Bag 461 has another sample of basalt (74275) that I picked up right near where we dug the trench.



Figure 2: Photo of 74255 (B1 surface). NASA S73-16905. Cube edge is 1 cm.

## Introduction

74255 was chipped from a large boulder on the rim of Shorty Crater (figure 1). It is a vesicular porphyritic, coarse-grained basalt with abundant ilmenite (high-Ti, type C) and is apparently identical to 74275. It is rounded with micrometeorite pits on one side and has one prominent fracture (figure 2). The crystallisation age of 74255 is about 3.8 b.y. with an exposure age of about 17 m.y. (age of Shorty Crater ~ 19 m.y.).

## Petrography

Dymek et al. (1975) carefully described the texture of 74255 and determined the chemical composition of all the phases. The crystallization sequence for 74255 starts with armalcolite and Cr-spinel, which are found as unreacted inclusions in both olivine and pyroxene cores. Olivine crystallized next, reacting with the melt to form augite before armacolite ceased crystallization. Ilmenite was next and is included in the augite phenocrysts as they zone to become more Fe-rich, followed by plagioclase and pigeonite which coprecipitated forming bundles of minerals defining

the basaltic texture. Fe-rich pyroxene, silica, Na-plagioclase and potassic mesostasis formed last (figure 3).

## Mineralogy

**Olivine:** Small olivine grains ( $\text{Fo}_{70}$ ) are found as cores of larger pyroxene phenocrysts (Dymek et al. 1975).

**Plagioclase:** Plagioclase ranges in composition from  $\text{An}_{86}$  to  $\text{An}_{76}$  with an average about  $\text{An}_{82}\text{Ab}_{14}\text{Or}_{0.5}$ .

**Pyroxene:** The cores of the pyroxene grains in 74255 are subcalcic augite ( $\sim\text{Wo}_{33}\text{En}_{52}\text{Fs}_{15}$ ), figure 4) with rims that are Fe-rich. Large pyroxene grains (4 mm) are often composite with complex zoning including hourglass structures. Some pigeonite coprecipitated.

**Ilmenite:** There is an abundance of ilmenite (figure 3).

## Mineralogical Mode for 74255

	Agrell PET	Brown et al. 1975	Dymek et al. 1975
Olivine	5 %	3.2 %	3.2
Plagioclase	33	18	27.6
Pyroxene	46	48.6	50.7
Opakes	16	38.6	15.1
Mesostasis	1	1.8	1.7

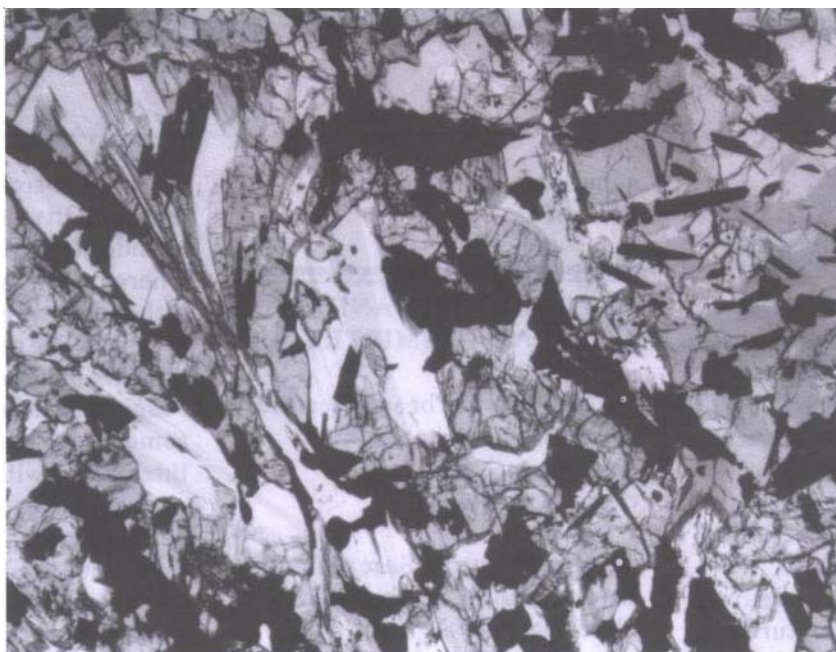


Figure 3: Photomicrograph of thin section of 74255 (from Neal and Taylor 1993). Field of view is 2.5 mm.

**Armalcrite:** Dymek et al. (1975) found rare grains of unmantled armalcrite in olivine and augite cores (table), but often rimmed by ilmenite within outer zones of pyroxene.

### Chemistry

The chemical composition of 74255 has been determined by Rhodes et al. (1976), Rose et al. (1975) and Dymek et al. (1975) (table 1). Trace element analyses are found in papers by Shih et al. (1975), Nunes et al. (1974) and Hughes and Schmitt (1985) (figure 6). The Ba/Rb vs. Sm discriminator groups it with type C, Apollo 17 basalts (figure 6). Hey, it's identical to 74275!

### Radiogenic age dating

Nyquist et al. (1976) and Murthy and Coscio (1976) dated 74255 by Rb/Sr (figures 7 and 8), consistent with the old age determined for 74275. Paces et al. (1991) give additional whole rock data for Sr and Sm isotopes.

**Table 2: Analysis of armalcrite.**

SiO <sub>2</sub>	0.07
Al <sub>2</sub> O <sub>3</sub>	2.12
TiO <sub>2</sub>	73.15
Cr <sub>2</sub> O <sub>3</sub>	1.59
FeO	17.35
MnO	0.16
MgO	6.2
ZrO <sub>2</sub>	0.09
total	100.73
Dymek et al. 1975	

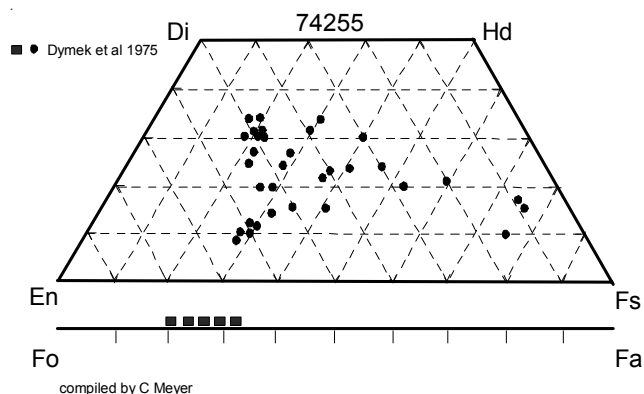


Figure 4: Pyroxene and olivine composition of 74255 (copied as best I can, from Dymek et al. 1975, with apologies).

### Cosmogenic isotopes and exposure ages

Eugster et al. (1977) and Morgelli et al. (1977) determined the cosmic-ray exposure age 17.3 m.y. by <sup>81</sup>Kr method. Considering partial shielding from the boulder, this is consistent with other exposure age determinations and it is concluded from these studies that the age of Shorty Crater is ~19 m.y.

### Other Studies

Usselman et al. (1975) determined the cooling rate of 74255 to be ~ 1 – 3 deg/hr.

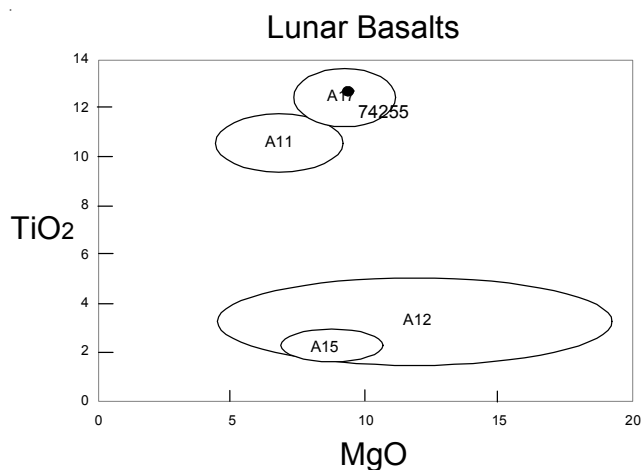


Figure 5: Chemical composition of 74255 compared with other Apollo basalts.

## Processing

A small slab was cut from ,2 in 1976 (figure 9).

There are two PAO display samples, one at the Onizuka Space Center, Kailua-Kona, Hawaii (figure 11). There are 12 thin sections.

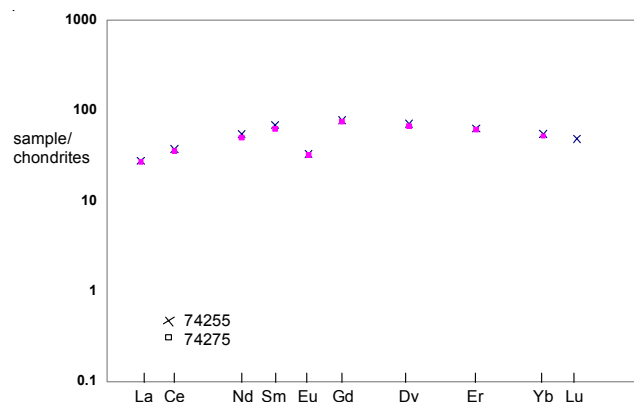
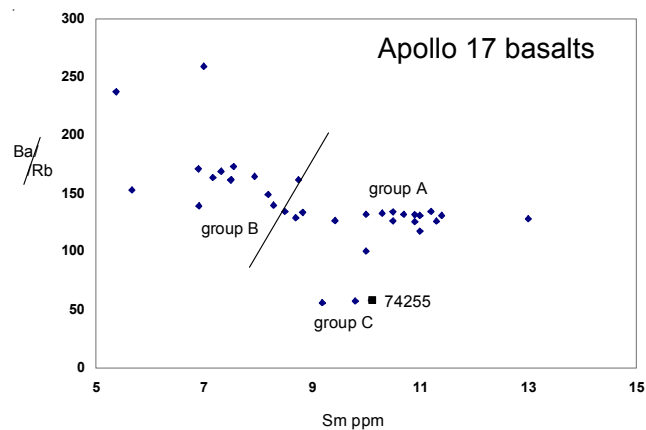


Figure 6: Trace element composition of 74255 showing that it is type C, A17 basalt.

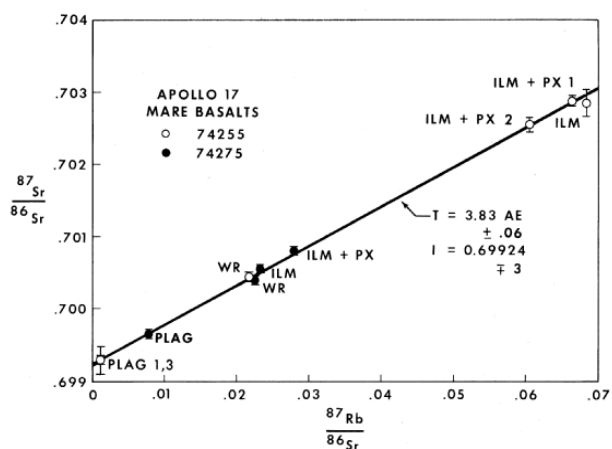


Figure 7: Internal Rb-Sr isochron for 74255 (Nyquist et al. 1976).

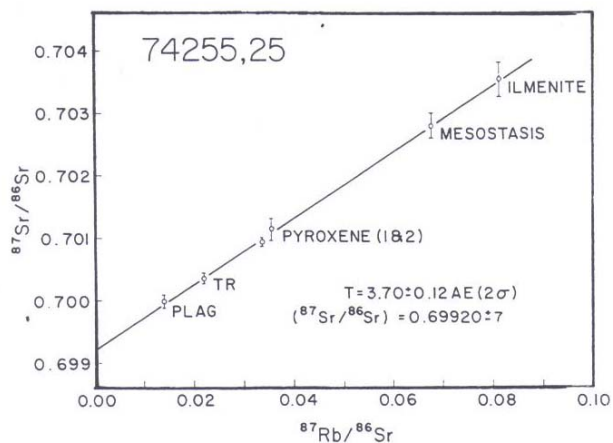


Figure 8: Internal Rb-Sr isochron for 74255 (Murthy and Coscio 1976).

## Summary of Age Data for 74255

	Rb/Sr
Nyquist et al. 1976	3.83 ± 0.06 b.y.
Murthy and Coscio 1976	3.7 ± 0.12
<b>Caution: Decay constant?</b>	

**Table 1. Chemical composition of 74255.**

<i>reference weight</i>	Wiesmann75 Shih 1975	Nunes74 Hughes85	Rhodes76	Rose75	Dymek75	Gibson75 Murthy76	Paces91
SiO2 %			37.96	(c ) 38.4	(d) 38.7	(e)	
TiO2			12.17	(c ) 12.76	(d) 12.6	(e)	
Al2O3			8.55	(c ) 8.84	(d) 9	(e)	
FeO			18.11	(c ) 17.98	(d) 17.6	(e)	
MnO			0.27	(c ) 0.28	(d) 0.23	(e)	
MgO			10.5	(c ) 10.72	(d) 10.7	(e)	
CaO			10.35	(c ) 10.2	(d) 10.2	(e)	
Na2O			0.36	(c ) 0.37	(d) 0.39	(e)	
K2O	0.081	(a)	0.08	(c ) 0.1	(d) 0.05	(e) 0.087	(a)
P2O5			0.05	(c ) 0.06	(d) 0.03	(e)	
S %			0.11	(c )	0.08	(e) 0.1625	
<i>sum</i>							
Sc ppm	82.7	(b)		62	(d)		
V				65	(d)		
Cr			4884	(c )			
Co	14.5	(b)		34	(d)		
Ni				17	(d)		
Cu				36	(d)		
Zn				5.4	(d)		
Ga				6.1	(d)		
Ge ppb							
As							
Se							
Rb	1.22	(a)		1.5	(d)	1.2	(a) 1.19
Sr	163	(a)		165	(d)	158	(a) 160
Y				126	(d)		
Zr		307	(b)	310	(d)		
Nb							
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb							
In ppb							
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm							
Ba	71.1	(a)		288	(d)		
La	6.5	(a)					
Ce	22.5	(a)					
Pr							
Nd	24.7	(a)					23.9
Sm	10.1	(a)					9.79
Eu	1.85	(a)					
Gd	15.3	(a)					
Tb							
Dy	17.3	(a)					
Ho							
Er	10	(a)					
Tm							
Yb	8.93	(a)		11	(d)		
Lu	1.18	(a)					
Hf		10	(b)				
Ta							
W ppb							
Re ppb							
Os ppb							
Ir ppb							
Pt ppb							
Au ppb							
Th ppm		0.445	(a)				
U ppm	0.14	(a) 0.132	(a)				
<i>technique: (a) IDMS, (b) INAA, (c ) XRF, (d) microchem., (e) calculated</i>							

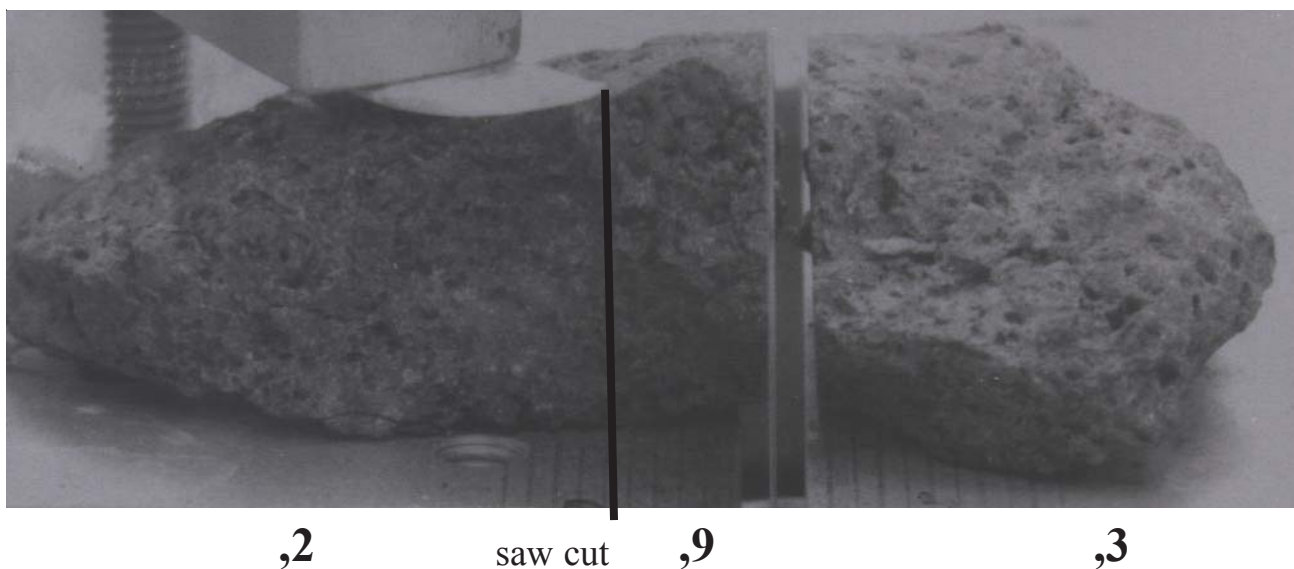


Figure 9: Cutting plan for 74255,2. Photo from data pack. Slab is 1 cm thick.

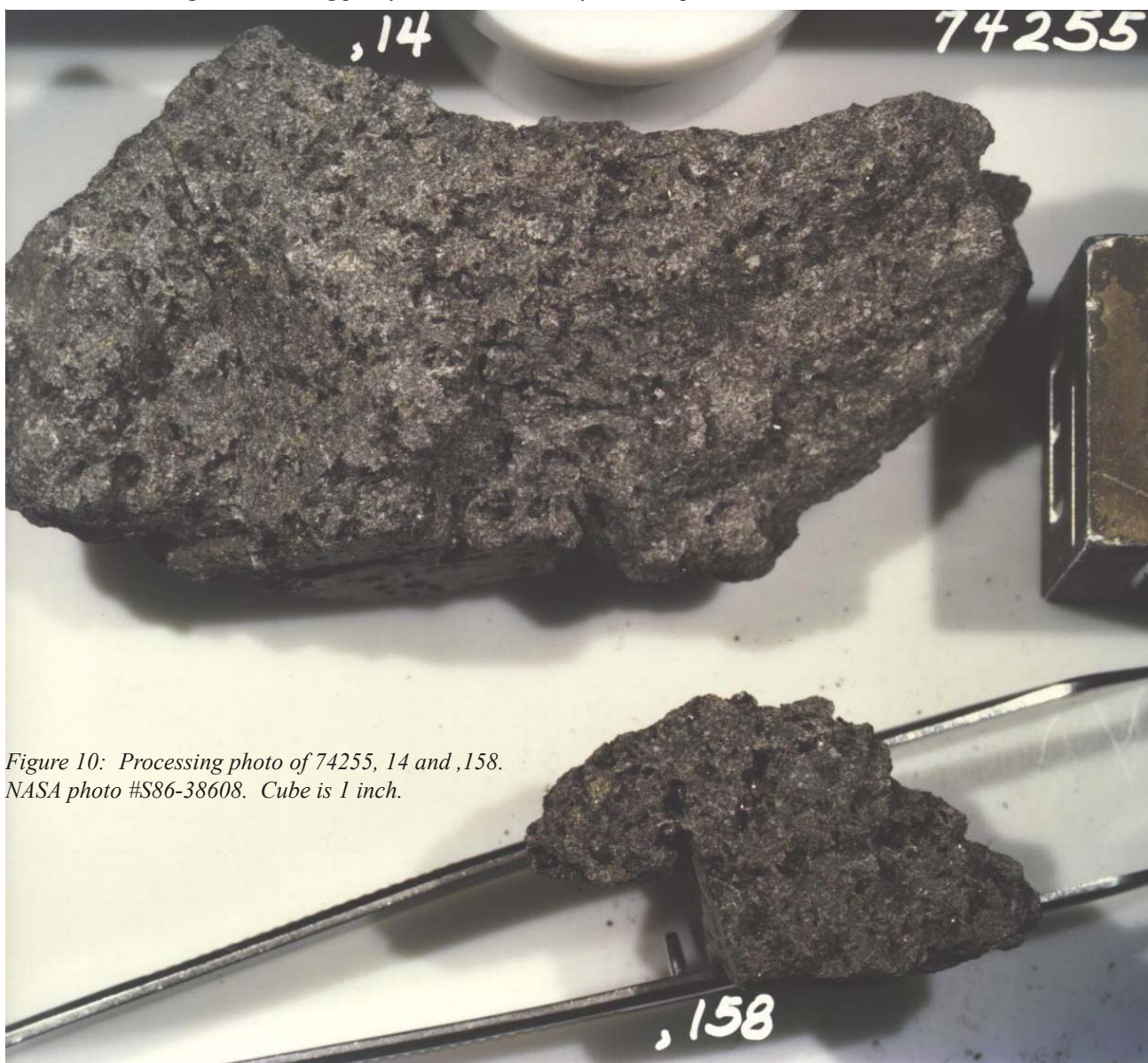


Figure 10: Processing photo of 74255, 14 and ,158.  
NASA photo #S86-38608. Cube is 1 inch.

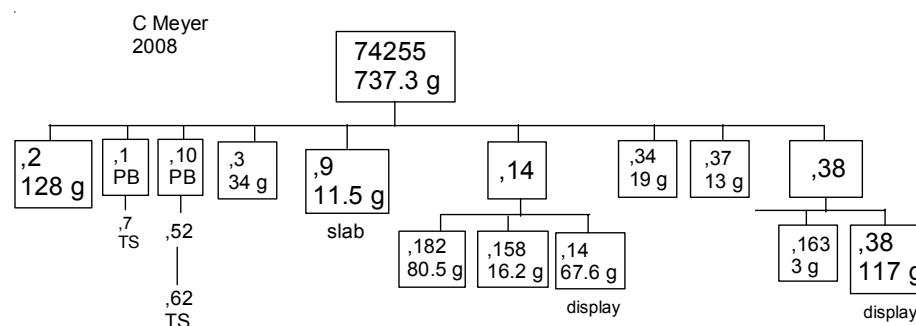


Figure 11: Display sample 74255,38.

### References for 74255

Bansal B.M., Wiesmann H. and Nyquist L. (1975) Rb-Sr ages and initial  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios for Apollo 17 mare basalts. In Conference on Origins of Mare Basalts and Their Implications for Lunar Evolution (Lunar Science Institute, Houston), 1-5.

Brown G.M., Peckett A., Emeleus C.H., Phillips R. and Pinsent R.H. (1975a) Petrology and mineralogy of Apollo 17 mare basalts. Proc. 6<sup>th</sup> Lunar Sci. Conf. 1-13.

Butler P. (1973) **Lunar Sample Information Catalog Apollo 17**. Lunar Receiving Laboratory. MSC 03211 Curator's Catalog. pp. 447.

Crozaz G. (1978) Regolith depositional history at Shorty Crater. Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf. 2001-2009.

Dymek R.F., Albee A.L. and Chodos A.A. (1975b) Petrology of Apollo 17 mare basalt 74255 (abs). Lunar Sci. VI, 230-232. Lunar Planetary Institute, Houston.

Dymek R.F., Albee A.L. and Chodos A.A. (1975a) Comparative mineralogy and petrology of Apollo 17 mare basalts: Samples 70215, 71055, 74255, and 75055. Proc. 6<sup>th</sup> Lunar Sci. Conf. 49-77.

Eberhardt P., Eugster O., Geiss J., Graf H., Grögler N., Morgeli M. and Stettler A. (1975a) Kr81-Kr exposure ages of some Apollo 14, Apollo 16 and Apollo 17 rocks (abs). Lunar Sci. VI, 233-235. Lunar Planetary Institute, Houston

Eberhardt P., Eugster O., Geiss J., Grögler N., Jungck M., Mauer P., Mörgeli M. and Stettler A. (1975b) Shorty Crater, noble gasses, and chronology (abs). Meteoritics 10, 93-94.

Eugster O., Eberhardt P., Geiss J., Grögler N., Jungck M. and Mörgeli M. (1977) The cosmic-ray exposure history of Shorty Crater samples; the age of Shorty Crater. Proc. 8<sup>th</sup> Lunar Sci. Conf. 3059-3082.

Gibson E.K., Usselman T.M. and Morris R.V. (1976a) Sulfur in the Apollo 17 basalts and their source regions. Proc. 7<sup>th</sup> Lunar Sci. Conf. 1491-1505.

Green D.H., Ringwood A.E., Hibberson W.O. and Ware N.G. (1975a) Experimental petrology of Apollo 17 mare basalts. Proc. 6<sup>th</sup> Lunar Sci. Conf. 871-893.

Hughes S.S. and Schmitt R.A. (1985) Zr-Hf-Ta fractionation during lunar evolution. Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf. in J. Geophys. Res. D31-D45.

LSPET (1973) Apollo 17 lunar samples: Chemical and petrographic description. Science 182, 659-672.

LSPET (1973) Preliminary Examination of lunar samples. Apollo 17 Preliminary Science Rpt. NASA SP-330. 7-1 – 7-46.

- Morgeli M., Eberhardt P., Eugster O., Geiss J., Grogler N. and Jungck M. (1977) The age of Shorty Crater (abs). Lunar Sci. VIII, 679-681. Lunar Planetary Institute, Houston.
- Muehlberger et al. (1973) Documentation and environment of the Apollo 17 samples: A preliminary report. *Astrogeology* 71 322 pp superceded by *Astrogeology* 73 (1975) and by Wolfe et al. (1981)
- Muehlberger W.R. and many others (1973) Preliminary Geological Investigation of the Apollo 17 Landing Site. *In* **Apollo 17 Preliminary Science Report**. NASA SP-330.
- Murthy V.R. and Coscio C. (1976) Rb-Sr ages and isotopic systematics of some Serenitatis mare basalts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1529-1544.
- Murthy V.R. and Coscio C. (1977) Rb-Sr isotopic systematics and initial Sr considerations for some lunar samples (abs). Lunar Sci. VIII, 706-708. Lunar Planetary Institute, Houston.
- Neal C.R. and Taylor L.A. (1993) Catalog of Apollo 17 rocks. Vol. 3 Central Valley
- Nunes P.D., Tatsumoto M. and Unruh D.M. (1974b) U-Th-Pb systematics of some Apollo 17 lunar samples and implications for a lunar basin excavation chronology. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1487-1514.
- Nyquist L.E. (1977) Lunar Rb-Sr chronology. *Phys. Chem. Earth* 10, 103-142.
- Nyquist L.E., Bansal B.M. and Wiesmann H. (1975a) Rb-Sr ages and initial  $^{87}\text{Sr}/^{86}\text{Sr}$  for Apollo 17 basalts and KREEP basalt 15386. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1445-1465.
- Nyquist L.E., Bansal B.M. and Wiesmann H. (1976a) Sr isotopic constraints on the petrogenesis of Apollo 17 mare basalts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1507-1528.
- Paces J.B., Nakai S., Neal C.R., Taylor L.A., Halliday A.N. and Lee D.-C. (1991) A strontium and neodymium isotopic study of Apollo 17 high-Ti mare basalts: Resolution of ages, evolution of magmas, and origin of source heterogeneities. *Geochim. Cosmochim. Acta* 55, 2025-2043.
- Rhodes J.M., Hubbard N.J., Wiesmann H., Rodgers K.V., Brannon J.C. and Bansal B.M. (1976a) Chemistry, classification, and petrogenesis of Apollo 17 mare basalts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1467-1489.
- Rose H.J., Baedeker P.A., Berman S., Christian R.P., Dwornik E.J., Finkelman R.B. and Schnepfe M.M. (1975a) Chemical composition of rocks and soils returned by the Apollo 15, 16, and 17 missions. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1363-1373.
- Shih C.-Y., Haskin L.A., Wiesmann H., Bansal B.M. and Brannon J.C. (1975a) On the origin of high-Ti mare basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1255-1285.
- Usselman T.M., Lofgren G.E., Donaldson C.H. and Williams R.J. (1975) Experimentally reproduced textures and mineral chemistries of high-titanium mare basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 997-1020.
- Wolfe E.W., Bailey N.G., Lucchitta B.K., Muehlberger W.R., Scott D.H., Sutton R.L. and Wilshire H.G. (1981) The geologic investigation of the Taurus-Littrow Valley: Apollo 17 Landing Site. US Geol. Survey Prof. Paper, 1080, pp. 280.